

Today's Topics:

Need help with BC200-XLT problem (LONG)

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From: att!cbnewsc!parnass@uchvax.Berkeley.EDU (Bob Parnass, AJ9S)

Subject: Need help with BC200-XLT problem (LONG)

In article <386400006@S57.Prime.COM>, STEVE\$@S57.Prime.COM writes:

> I was wondering if any other BC200-XLT owners have encountered a
> problem with low-battery shutoff....
> My thought is that 7.4v is way to high a threshold for low-battery
> state....
>
> Steve Meserve N1FZA

I discussed the NiCd battery life problem of the Uniden/Bearcat 200XLT scanner in a series of articles published earlier this year in my column in the "RCMA Newsletter." Some of those articles are appended to this posting.

Since that time, I have experimented further with my 200XLT, shorting out Zener diode D203. This has the effect of recalibrating the low battery warning indicator to activate in the 4 to 5 volt range. This is low enough to get full use from the batteries, but too low to warn the user in time to risk reverse chaging a cell.

Since my scanner did not have a severe problem, I elected not to leave D203 shorted in my scanner, and restored the original circuit.

by Bob Parnass, AJ9S

The Uniden/Bearcat 100XLT and 200XLT scanners are the first portable scanners with enclosed, slide on battery packs. Some 200XLT owners don't get the battery life they expect. They report having to recharge the slide on NiCd (Nickel Cadmium) battery pack after as few as only 3-1/2 hours of operation. Owners expect the battery pack to last longer, at least the 5 hours mentioned in the documentation supplied with the radio.

Much has been written about NiCd battery characteristics and charging in general. This article will not rehash general NiCd charging techniques. Rather, we will analyze the current consumption of the Uniden/Bearcat 200XLT scanner, and make recommendations specific to that radio.

BP-200 Battery Pack

The BP-200 battery case contains six Sanyo 600 mAh NiCd cells soldered in series configuration and wrapped in heat shrunk plastic. This pack furnishes 7.2 VDC to the radio. A charging regulator circuit and a light emitting diode are also contained within the battery case.

In contrast to the Yaesu FT-23R 2 meter walkie-talkie, which is supplied with a wall-mounted charger, the 200XLT wall-mount unit is actually a 12 VDC power supply. Since the BP-200 regulator circuitry is contained within the battery case, 200XLT owners cannot easily opt for rapid or trickle chargers.

Measurements and Their Implications

The 200XLT's current drain was measured under several conditions, and a graph appears later in this paper. Tests show that the 200XLT consumes more current on higher bands than it does on lower bands. For instance, listening on the 870 MHz band takes 13 mA more current compared with the vhf-lo band.

Measurements indicate that 200XLT current consumption is independent of scanning, searching, or manual modes, provided the scanning or searching is within the same band. This implies:

- o If you must monitor 870 MHz frequencies for a prolonged period, it is more "battery-wise" to scan a mixture of 870 MHz and low band channels.

Several factors can contribute to "shortened" battery life. Shortened recharge intervals will be needed if using the radio with the volume control at a loud setting. In portable receivers, the audio amplifier stage generally consumes more current than any other stage. The 200XLT has a more powerful, cleaner audio output stage than do other portable scanners.

The factory supplied earphone is inconvenient and uncomfortable, but test results prove:

- o Using the earphone decreases current consumption.

Using an earphone saves about 14 mA indoors, and about 50 mA in noisy situations where one might have the volume control set at maximum.

When using an earphone with the test radio, the best volume control setting was at the 10 o'clock position, versus 12 o'clock when using the internal speaker.

Listening to "busy" channels generally consumes more current than listening to infrequently used channels. One surprising exception, borne out by test results, is that:

- o When using an earphone (at 10 o'clock volume setting), listening to busy channels actually consumes

less current than when the 200XLT is fully squelched!

Improper battery charging can require the battery be charged more often than normal. If the battery indicator on the 200XLT's panel flashes, charge the battery pack for a full 16 hours. Test results showed:

- o The low battery indicator flashes when battery voltage falls to 7.2 volts or less.

The 200 memory channels in the 200XLT are backed up by a capacitor kept charged by the NiCd battery pack. Current is required to retain the memory information, even when the radio is turned off.

How much battery drain is due to maintaining the memory information? To answer this question, the author measured the current required to backup the memory in the

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200XLT. A Fluke 8024B digital multimeter indicated that:

- o The 200XLT draws about 0.50 mA with the power switched off.

The six cell Sanyo NiCd pack is rated for 600 mAh capacity. If the batteries were perfect, and had infinite shelf life, the memory backup would drain a fully charged battery flat in 50 days:

$$\begin{aligned} 600 \text{ mAh} / 0.50 \text{ mA} &= 1200 \text{ hours} \\ &= 50 \text{ days} \end{aligned}$$

But no NiCd battery is perfect -- all have a finite shelf

life. NiCd batteries will discharge by themselves, through spontaneous chemical decomposition, even when not connected to a load. The General Electric Company indicates that the average NiCd will lose about 1% of its capacity per day at 70 degrees F.

The author developed a discrete time computer simulation which shows that:

- o The cumulative effects of self discharge, combined with 0.50 mA drain due to memory backup, will deplete a fully charged 200XLT battery pack in about 40 days.

A plot of the predicted daily decrease in battery capacity appears elsewhere in this article. The plot indicates that:

- o To get the most use between recharges, charge your 200XLT right before using it. If you charge your 200XLT battery, but then leave it in a drawer for a week, you will have already lost 20% of the operating time before the next recharge is required.

Average self discharge at 100 degrees is about double (2% per day) the discharge at 70 degrees, which is a good reason to avoid storing NiCd batteries in a warm automobile. At 100 degrees, it only takes about 34 days to deplete the 200XLT battery.

Low Battery Indicator

As stated earlier, the 200XLT low battery indicator begins to flash when battery voltage decreases to 7.2 volts or less. This starts a 10 minute timer within the 200XLT. After the low battery indicator has flashed for

10 minutes, the 200XLT display blanks.

- o Experimental results show that even after the 200XLT display goes blank, the radio will continue to draw approximately 50 mA.

In the author's opinion, the display blanking feature is a liability, not an asset, of the 200XLT. The owners' guide claims the 10 minute timer and display blanking sequence is designed to alert the user and prevent the batteries from full discharge. But, this assumes the user will notice the display is blank and take action.

Owners have been known to get up to 2 hours more use from the NiCd battery pack after the low battery indicator begins to flash. They turn the radio off, then back on, which resets the 10 minute timer.¹ Uniden should just let the low battery indicator flash, omit the timer, and let the user decide what to do and when to do it. This would permit the 200XLT to be used longer.

Measuring BP200 Battery Capacity

The BP200 battery pack contains 6 cells and is rated at 600 mAh. Ron Smithberg experienced short battery life in his 200XLT. We measured the capacity of his battery using a procedure similar to the one recommended by General Electric and Motorola. Basically, we timed how long it took to discharge a fully charged battery using a resistor to draw current at its one hour rate. This test considers NiCd cells measuring 1.0 volts or less as "discharged."

1. We charged Ron's battery for 16 hours using the factory supplied wall power supply.
2. We placed a variable power resistor (approximately 12 ohms) across the battery terminals, and kept it adjusted to draw 600 mA from the battery.

1. Be forewarned that turning the radio off and on rapidly in succession may cause the memory to be lost.² This may be due to a transient voltage spike. A note in November 1988 Monitoring Times recommended the addition of a 100 uF capacitor soldered across the battery to prevent transients.

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3. We monitored the battery voltage during the entire test. When the pack voltage decreased to 6 volts, we noted the time, and stopped the test.

It took only 44 minutes for the 6 cell pack voltage to decrease from over 8 volts to 6 volts. Thus, the battery capacity was only:

$$\begin{aligned} &600 \text{ mA} \times 44 \text{ minutes} \\ &= 26,400 \text{ mA-minutes} \\ &= 440 \text{ mA-hours} \end{aligned}$$

After performing the capacity test, Ron recharged his battery for 16 hours then used it immediately. He was then able to get more than 9 hours use, much longer than before. Apparently, Ron's battery was suffering the effects of NiCd memory.

NiCd Memory Effect

The owners' literature recommends that 200XLT owners run their batteries down periodically to avoid a NiCd "memory" effect.

- o Avoiding the effects of NiCd "memory" is perhaps more important for the 200XLT than it is for other portable radios.

Owners who always recharge their battery packs at the first blink of the low battery indicator will not extract the full capacity of their battery. They will decrease its capacity.

Cell reversal can occur if NiCd batteries are permitted to fall below 1.0 volts per cell. There are at least 2 ways to "run" the battery down safely:

1. As described in the cell capacity test above, discharge the fully charged pack into a 12 ohm, 10 watt resistor until the pack voltage is down to 6 volts. This should take an hour or less. Then, recharge the battery for 16 hours.
2. Leave the 200XLT scanner on after the low battery indicator flashes and the LCD display blanks. Periodically remove the battery and measure its voltage. When the battery pack voltage reaches 6 volts, recharge the battery for 16 hours. This

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method will take longer and it is easier for an owner to forget and let the battery voltage dip too low (below 6 volts). This may cause the loss of programmed frequencies, as well as possible NiCd cell reversal.

Conclusion

The low battery alert feature of the Uniden/Bearcat 200XLT is too conservative, and disables the radio prematurely. Owners can get longer use from their NiCd battery packs if they adopt good charging habits, such as discharging their pack down to 6 volts, and charging for 16 hours just before using the radio.

References

1. Parnass, Bob, AJ9S, "Uniden/Bearcat 200XLT Scanner Review," RCMA Newsletter. October 1988.
2. Nickel-Cadmium Battery Application Engineering Handbook, Second Edition, General Electric Company, Battery Business Department. P.O. Box 861, Gainesville, FL 32602. Copyright 1975. pp 7-14, 7-15.

For further information on NiCd batteries, see:

- The ARRL Handbook for the Radio Amateur, 65th Edition. The American Radio Relay League, Newington, CT. Copyright 1988. ISBN 0-87259-065-8. pp 6-25, 6-26, 6-27, 6-28.
- Meyer, Budd, K2PMA, "Charge It! Your NiCad, That Is," QST, March 1977. pp 29-31.
- Meyer, Budd, K2PMA, "Nickel-Cadmium Pandemonium," QST, March 1982. pp 32-34.

Additional Current Consumed by Uniden/Bearcat 200XLT Per Band Over VHF-lo Band	
Band	Additional Current (mA)
VHF-hi	1
UHF	5
870	13

Uniden/Bearcat 200XLT Scanner Current Consumption Measured Under Various Operating Conditions		
Condition	Measured Current Consumption (mA)	
sqlch closed vhf-lo	49	*****
sqlch closed vhf-hi	50	*****
sqlch closed uhf	54	*****
sqlch closed 870	62	*****
sqlch open 10oclock vhf-lo	48	*****
sqlch open 10oclock vhf-hi	49	*****
sqlch open 10oclock uhf	53	*****
sqlch open 10oclock 870	61	*****
sqlch open 11oclock vhf-lo	57	*****
sqlch open 11oclock vhf-hi	58	*****
sqlch open 11oclock uhf	61	*****
sqlch open 11oclock 870	69	*****
sqlch open 12oclock vhf-lo	64	*****
sqlch open 12oclock vhf-hi	65	*****
sqlch open 12oclock uhf	68	*****
sqlch open 12oclock 870	76	*****

sqlch open full vol vhf-lo	99	*****
sqlch open full vol vhf-hi	100	*****
sqlch open full vol vhf-uhf	104	*****
sqlch open full vol vhf-870	112	*****

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Predicted Shelf Life of Uniden/Bearcat BP-200 Battery Battery Pack While Connected to 200XLT Scanner		
Day	% of Original Capacity Remaining At End of Day	
1	97%	*****
2	94%	*****
3	91%	*****
4	88%	*****
5	85%	*****
6	83%	*****
7	80%	*****
8	77%	*****
9	74%	*****
10	72%	*****
11	69%	*****
12	66%	*****
13	64%	*****
14	61%	*****

15	58%	*****
16	56%	*****
17	53%	*****
18	51%	*****
19	48%	*****
20	46%	*****
21	43%	*****
22	41%	*****
23	38%	*****
24	36%	*****
25	34%	*****
26	31%	*****
27	29%	*****
28	27%	*****
29	25%	*****
30	22%	*****
31	20%	*****
32	18%	*****
33	16%	*****
34	14%	*****
35	12%	****
36	10%	***
37	7%	**
38	5%	*
39	3%	*
40	1%	

Computer model based on these assumptions:

1. A new battery, fully charged to 600 milliampere-hour capacity at start of day 1.

2. Continuous drain of 0.50 mA to retain 200XLT memory.

3. Ambient temperature 70 degrees F.

LOW BATTERY INDICATOR IN THE UNIDEN/BEARCAT 200XLT SCANNER

by Bob Parnass, AJ9S

Some Bearcat 200XLT scanner owners don't get the battery life they expect. They report having to recharge the slide on NiCd (Nickel Cadmium) battery pack after as few as only 3-1/2 hours of operation.

Last month, I discussed the results of several tests made on the 200XLT portable scanner to determine its current consumption. This month, I propose cures for the overly conservative low battery indicator problem.

As presented earlier, the 200XLT low battery indicator begins to flash when battery voltage decreases to 7.2 volts or less. This starts a 10 minute timer within the 200XLT. After the low battery indicator has flashed for 10 minutes, the 200XLT display blanks.

The low battery indicator in three 200XLTs examined is too conservative. Owners have been known to get up to 2 hours more use from the NiCd battery pack after the low battery indicator begins to flash.

The 200XLT Service Information Manual specifies the low battery threshold should be 6.9 volts nominal, with an acceptable range of between 6.5 and 7.2 volts. However, the 7.2 volt threshold measured in 200XLTs is almost out of range.

Zener diode D203, type HZK3CLL01TR, a surface mount com-

ponent located on the Micom (microcomputer) circuit board, determines the low battery detection threshold.

I have not attempted to alter the 200XLT low battery circuit, but it looks like there are a few ways for an adept technician to fix it:

1. The threshold could be reduced if D203 were to be replaced with a zener diode of lower voltage.
2. The low battery circuit could be bypassed completely using one of two methods:
 - a. by removing D203, and connecting the input of regulator IC204 to the output of IC208, a 5 volt regulator, or
 - b. by removing R208, and replacing D203 by a jumper wire.

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The only drawback I could see is that defeating the low battery circuit might cause memory loss when the battery voltage becomes too low, because the micro-computer doesn't detect the low voltage soon enough.

Again, the previous suggestions are conjecture, as I have not tried either modification. Readers are cautioned: experimenting with the 200XLT circuitry is risky. The surface mount parts are tiny and the land patterns on the circuit boards are fragile.

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